424 Rec'd PCT/PTO 26 JUL 2000

FORM PTO-1390 (REV 12-29-99) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER

U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 09/601013

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE99/00369	17 Feb. 1999	18 Feb. 1998

TITLE OF INVENTION
DEVICE FOR TESTING THE ELECTROMAGNETIC COMPATIBILITY OF SYSTEMS HAVING LARGE DIMENSIONS

APPLICANT(S) FOR DO/EO/US
WILBERT, JAN PAUL

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   - b. ☒ has been transmitted by the International Bureau.
   - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   - b. ☐ have been transmitted by the International Bureau.
   - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   - d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.

Please send me an email that you received:
- Transmittal Letter
- Translation of the International Application
- ~~[illegible]~~
- Examination Report and transl. of the Annexes
- Credit Card Payment Form with the right payment amount

to jan.wilbert@t-online.de

Thanks in advance!

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U.S. APPLICATION NO (if known, see 37 CFR 1.5) 09/601013	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER

	CALCULATIONS	PTO USE ONLY
17. ☐ The following fees are submitted: **BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :** Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO .... **$970.00** International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO .... **$840.00** International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO .... **$690.00** International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) .... **$670.00** International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$96.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	- 20 =		X $18.00	$	
Independent claims	- 3 =		X $78.00	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $260.00	$	
TOTAL OF ABOVE CALCULATIONS =				$	
Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also by filed (Note 37 CFR 1.9, 1.27, 1.28).				$	
SUBTOTAL =				$	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED =				$ 840	
				Amount to be refunded:	$
				charged:	$

a. ☒ A ~~check~~ in the amount of $ 840 to cover the above fees is enclosed.
↳ credit card payment form

b. ☐ Please charge my Deposit Account No. ____________ in the amount of $____________ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☐ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. __________. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO.

Dr. Jan P. Wilbert
Riegerweg 7
82024 Taufkirchen
Germany

D. Jan P. Wilbert
SIGNATURE

Dr. Jan Paul Wilbert
NAME

REGISTRATION NUMBER

ART 34 AMDT

G/PRTS

09/601013

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Device for testing the electromagnetic compatibility of systems having large dimensions

Especially in the military field it is **known** that EMC-susceptibility tests are based on a pulse-shaped short stimulation. With these test by far stronger inhomogeneous fields come to application. Through the usual shape of the wave guides from the source to the termination of the impulse, no optimal testing field for civil requirements can be produced. Bends in the wave guide, geometrical changes of the wave guide from the source to the termination relative to its return conductor, a mismatched adaptation between the measurement of the equipment under test and the testing volume, the arrangement of the loading device in the testing volume and the testing volume loss originating by this, rail shaped and other sparking gaps between impulse source and field-generating wave guide arranged in an angle to the wave guide which differ largely in the geometry from the wave guide, lead to reflections which influence the extension of the pulse negatively and, by this, lead to a deterioration of the produced electromagnetic field in the testing volume. Furthermore, too long wave guides lead to an obliteration of the pulse, respectively a radiation of energy, as usual in many installations, and, with that, restrict its frequency spectra. With sine shaped fed wave guides or strip lines dimension-conditioned frequency range restrictions occur. Also with other similar testing methods, as the use of antennas with a determined directive diagram in an appropriate dimensioned unachoic chamber as usual in the automobile technique, no economical justifiable testing against electromagnetic radiated fields is possible for larger systems. In particular, no special susceptibility test for a whole train is existing at present.

Burst generators, which produce nano second impulses (5/50 ns) in fast succession and over controllable spark gaps with variable amplitudes, belong also to the state of art in the technique (DE 43 40 514 C2). However, conditioned by construction, these burst generators cannot replace a testing device described in the above mentioned patent claim for systems having large dimensions but serve rather the conductor led component test.

The advantages obtained by the invention consist in particular of the enormous time saving in testing time, the obtained field quality and the applicability for any long equipment under test with simultaneous minimal length of a single pulse conducting wave guide achieved through the modular structure. The test of a whole train in ~~the far~~ field, without a movement of the radiation

source while keeping the field homogeneity, can be conducted with a wave guide width differing only little from the train width.

The invention mentioned in the patent claim underlies the **problem**, to create generally for a complete system having large dimensions, a homogeneous testing field accepted by rules of the civil EMC-susceptibility-technique (ENV 50140).

This problem will be **solved** by the characteristics mentioned in patent claim 1 that several of these IGW, ICW, return conductors and terminating characteristic impedance's in the described arrangement combine units parallel, modular, to a common triggering mechanism and, by this, creating a testing chamber applicable for a system with large dimensions.

The **advantages** obtained by the invention consist especially in, instead of the piecewise EMC-susceptibility-test of systems with large dimensions leading to wrong results, a complete illumination of the equipment under test can be made (all) at once in nano seconds or in a few seconds while running repeatingly. Through keeping the characteristic impedance, a testing field with extraordinary quality will be produced.

The **testing chamber** with large dimensions results from the parallel mounting of the module shown in figure 1 with further modules equal in construction. A change of the field polarization can be reached by turning the arrangement around the length axle of equipment under test.

Impulse production

At first, the IGW is unloaded. Over a triggered spark gap the IGW or all parallel switched IGWs will be charged simultaneously through a high voltage source to a voltage U_o (preferably DC-voltage). The spark gap extinguishes due to the resulting potential equality and the regress of current intensity resulting from this. The impulse will be released independently after approx. 100 ms by closing the rail gap by means of many little arcing channels which connect the IGW with the ICW as a load. With the help of the rail shaped spark gap arises an equal electromagnetic impact of the ICW with the impulse. The maximal width of the rail shaped spark gap and, by this, the width of a module results from manufacturing possibilities.

With the usual excitation of a wave guide at a point, this leads, through the different conductor length, to a time delay of the current on the single wave guides. This delay in time of the wave on the different rods leads, as the inductivity of the spark gap and the change of the characteristic impedance to a obliteration of the flanks of the rectangular shaped impulse and, by this, to a loss in frequency range width of the produced frequency spectrum.

In the case of the rail shaped spark gap the load will be adapted to the impedance of the loading device. Thereby, the initial value of the voltage amounts exactly $U_o/2$. Through the voltage step from U_o to $U_o/2$, a travelling wave will be produced which runs in the directions of the IGW-beginning. After a transmission time τ of the used wave guide the travelling wave reaches the IGW-beginning, will be reflected almost completely at the high resistant spark gap ($r_u = 1$) and a resulting voltage zero arises. After the double running time 2 τ the wave reaches the IGW-end again. With an arcing spark gap, it is completed reflection free ($r_u = 0$). A voltage impulse arises on the ICW. This impulse will jump at the time of switching from zero to $U_o/2$ and after 2 τ again to zero.

Field quality

The whole testing chamber fulfils the sense of the requirements of the ENV 50140 and is suitable for testing the **susceptibility** test relative to the field homogeneity. A comparison extending the requirements of the ENV 50140 onto the three levels in the testing chamber shows

the in fig. 5 illustrated variation between point 14 as reference point and respectively all other measuring points (6 to 12 possible points exceed the 6-dB-criterion).

Patent claims

1. Device for testing the electromagnetic compatibility and (EMC)-susceptibility, especially for systems having comparatively large dimensions as wagons and/or trains, with impulse generating wave guides (IGW) which are arranged parallel and show electrical conducting single rods (2) switched together over an head electrode (5), which are connectable over a rail-shaped spark gap (4) in direct line with impulse-conducting wave guides (ICW), which, in return, are connected preferable right angled with an terminating characteristic impedance (6) in order to build up a testing chamber for the system to be tested, which, preferably right-angled attached, with one or several return conductors is switched together, at which the magnitude of the terminating characteristic impedance (6) with, at the most a few ohm difference, correspond to the impulse generating wave guide (IGW).

2. Device after claim 1, is characterized that the terminating characteristic impedance (6) which is developed planar or is consisting of several single characteristic impedance's.

3. Device after claim 1 or 2, is characterized that several of the devices are switched together as modules in order to lengthen the testing chamber.

4. Device after claims 1 – 3, is characterized that the rail-shaped spark gap (4) is assigned for a tube with variable pressure.

5. Device after claims 1-4, is characterized that testing of the systems is practicable repeatingly in the range of nano seconds to seconds.

6. Device after claim 1, is characterized that the impulse generating wave guide (IGW) is arranged parallel to the return conductors with essentially the same characteristic wave impedance as the ICW.

Summary

EMV-testing device for systems having large dimensions

According to the law for electromagnetic compatibility of 1 January 1995 all electrical apparatus must have a certain resistance to interference by electromagnetic fields. Especially in the case of systems having large dimensions, such as trains, it is at present not possible to carry out such a test economically using conventional methods. The invention relates to a test device, which makes such a testing possible and beneficial. According to the invention, a test device consists of a novel arrangement of an impulse-generating wave guide (IGW), which consists of parallel, electrically conductive individual rods, which are connected over by a head electrode and, via a rail-like spark gap which is in a straight line with an impulse--conducting wave-guide (ICW) which is identical in structure but longer, is closed at right angles with a terminating resistor. A return line is connected to said terminating resistor. Several of these IGW, ICW, return lines and termination resistors arranged as described above can be connected in parallel in a modular manner via a shared release mechanism and therefore create a testing space suitable for a large system.

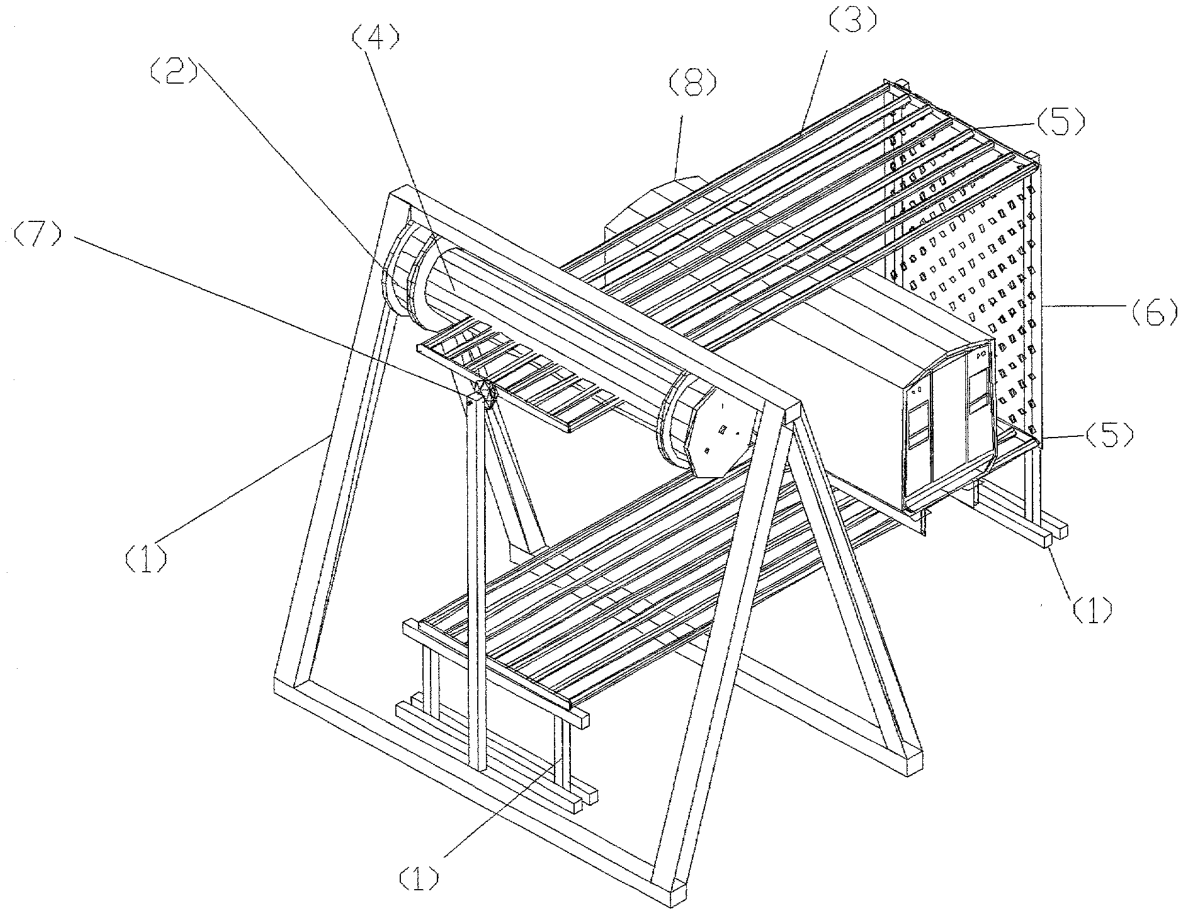

Fig. 1 A performance example of a module with a carrying rack, a high voltage connection and an equipment under test section in vertical polarization

(1) Rack out of electrical, non-conducting material
(2) IGW
(3) ICW
(4) Pressure tube and rail-shaped spark gap
(5) Bus bar
(6) Terminating impedance
(7) Triggered first spark gap and high voltage source connection

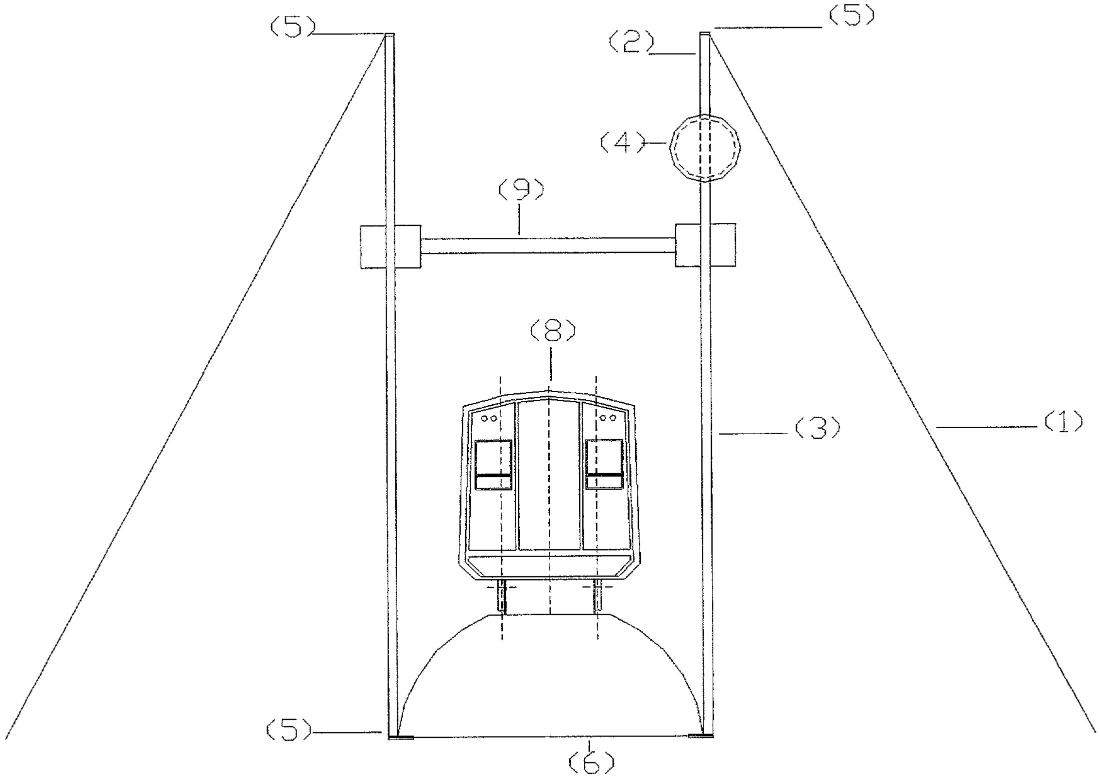

Fig. 2 A performance example of the horizontal polarization

(1) Wooden rack

(2) IGW

(3) ICW

(4) Pressure tube and rail-shaped spark gap

(5) Bus bar

(6) Terminating characteristic impedance

(7) Triggered first spark gap and high voltage source connection

(8) Train section in the testing chamber

(9) Synthetic column

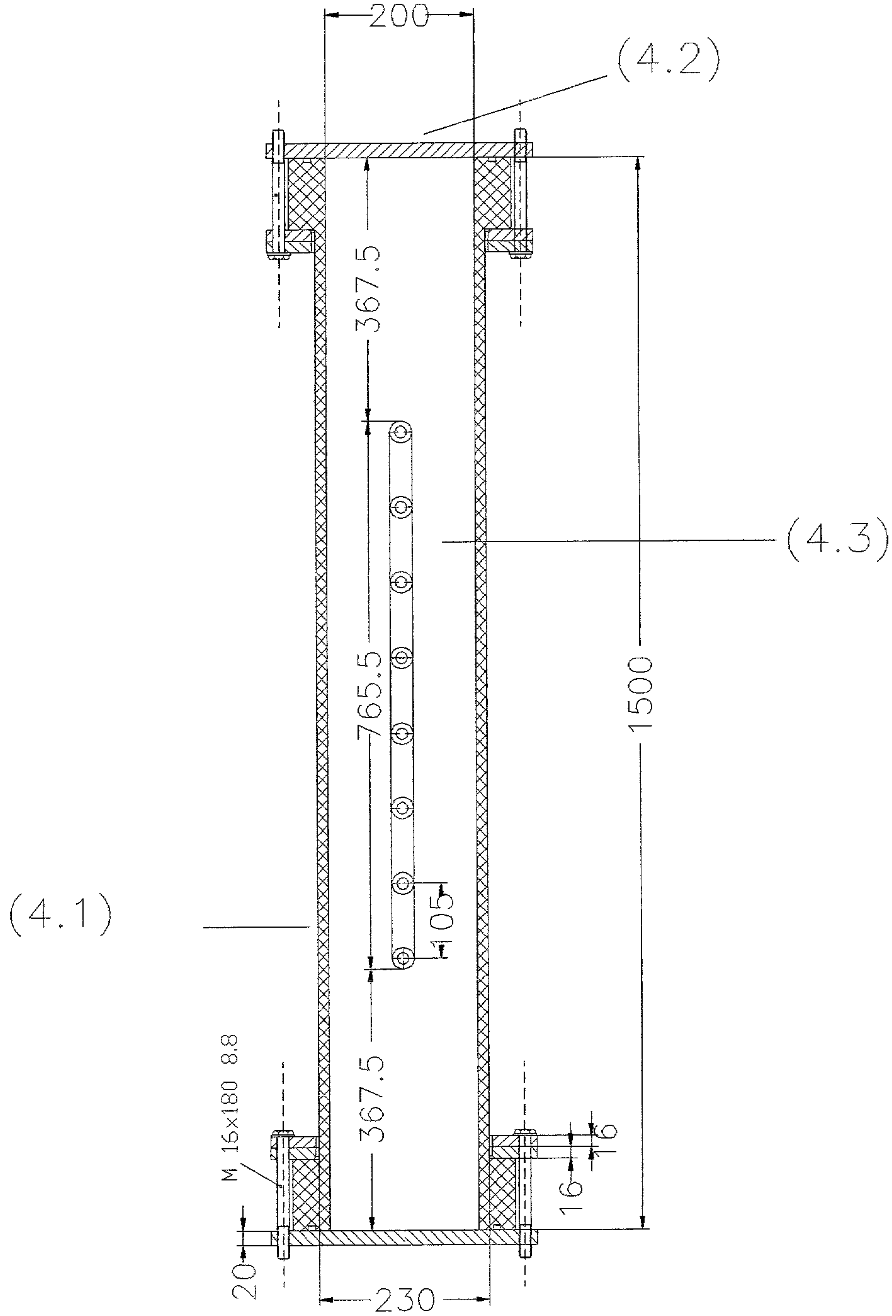

Fig. 3 A performance example of the pressure tube with electrode as detail of figure 1 and figure 2

(4.1) GFK-tube

(4.2) Lit

(4.3) Rail-shaped electrode, serves as connection for the single wave guides at the same time

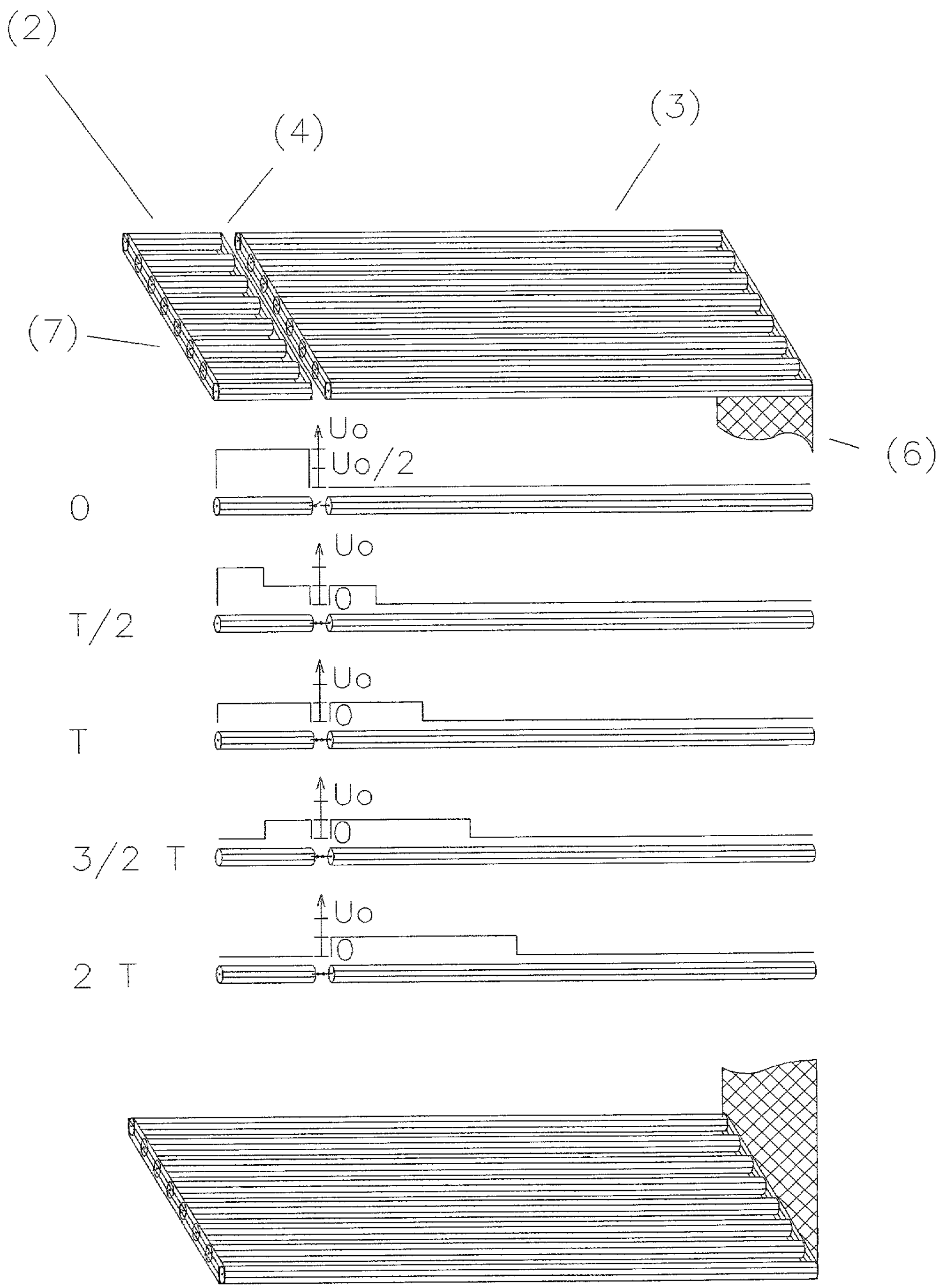

Fig. 4 Function

(1) IGW

(2) ICW

(3) Rail-shaped spark gap

(4) Terminating impedance

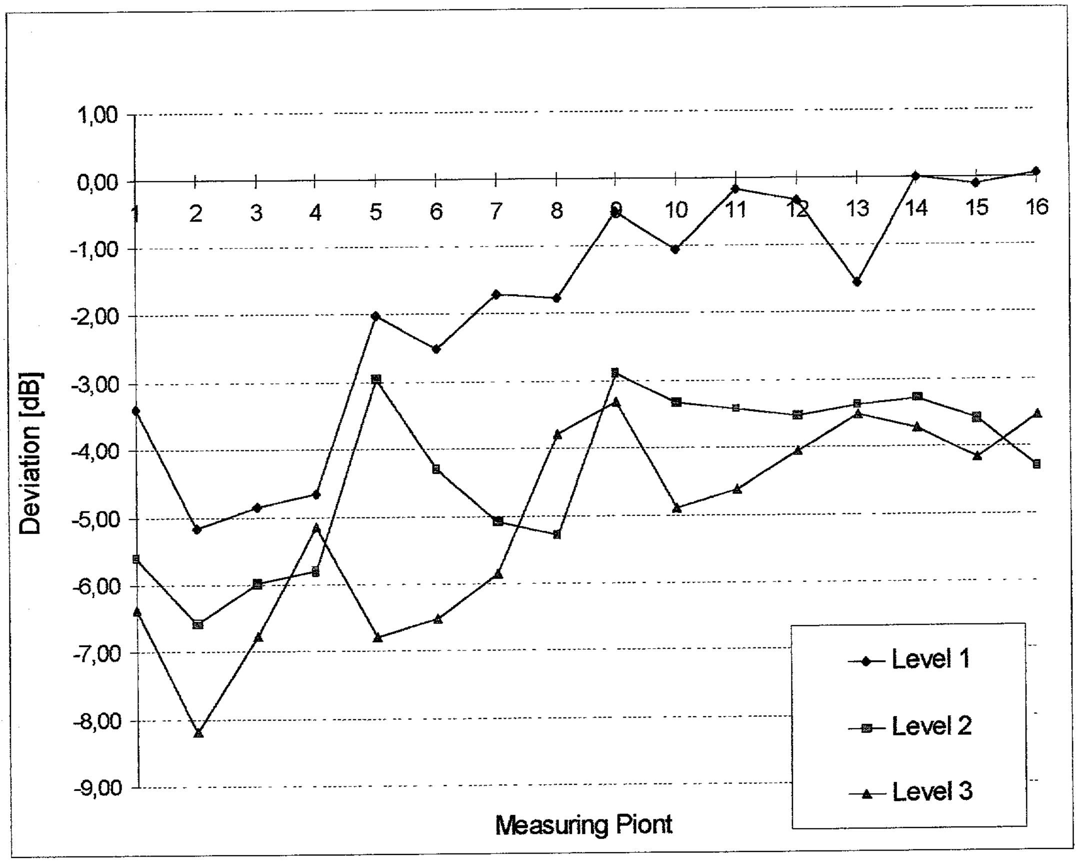

Fig. 5 6-dB-criteria of all measuring points in the testing chamber

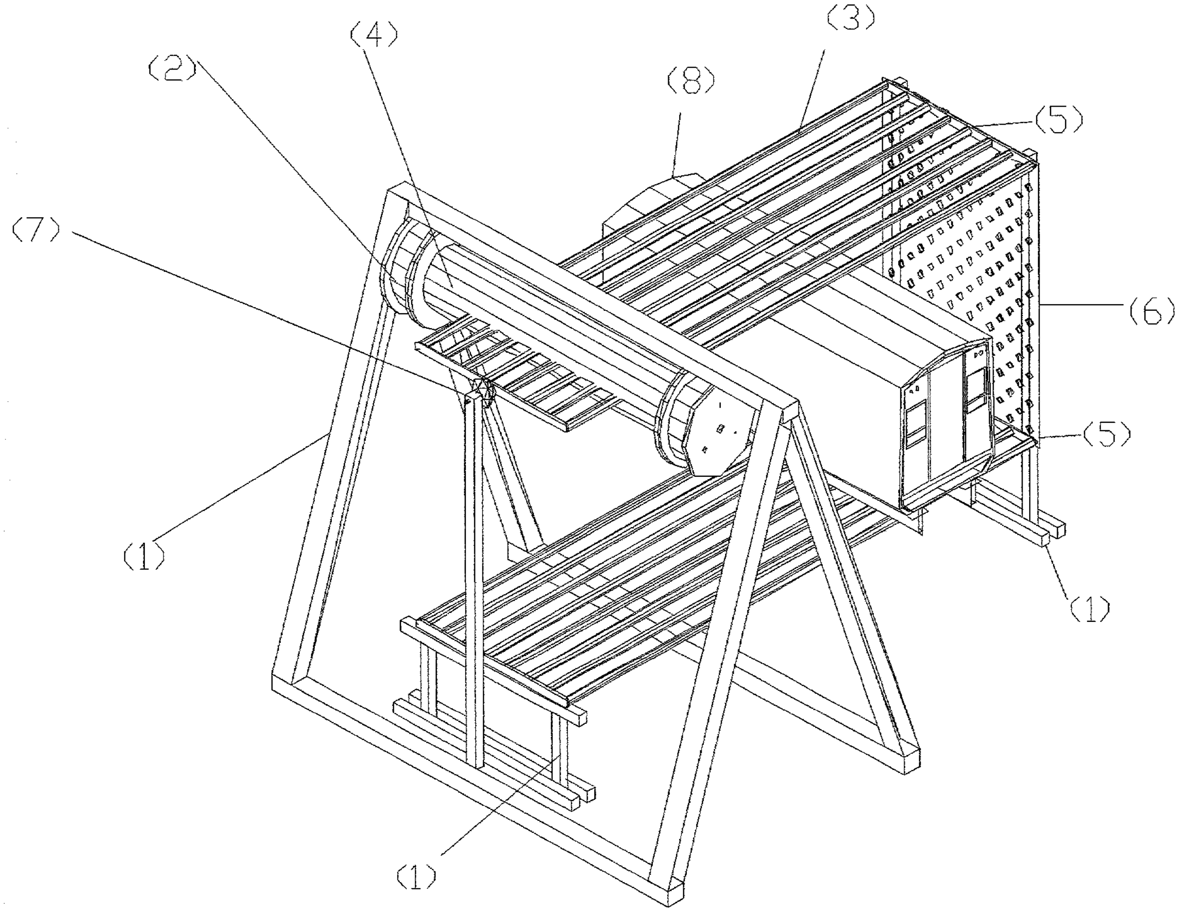

Fig. 1 A performance example of a module with a carrying rack, a high voltage connection and an equipment under test section in vertical polarization

(1) Rack out of electrical, non-conducting material

(2) IGW

(3) ICW

(4) Pressure tube and rail-shaped spark gap

(5) Bus bar

(6) Terminating impedance

(7) Triggered first spark gap and high voltage source connection

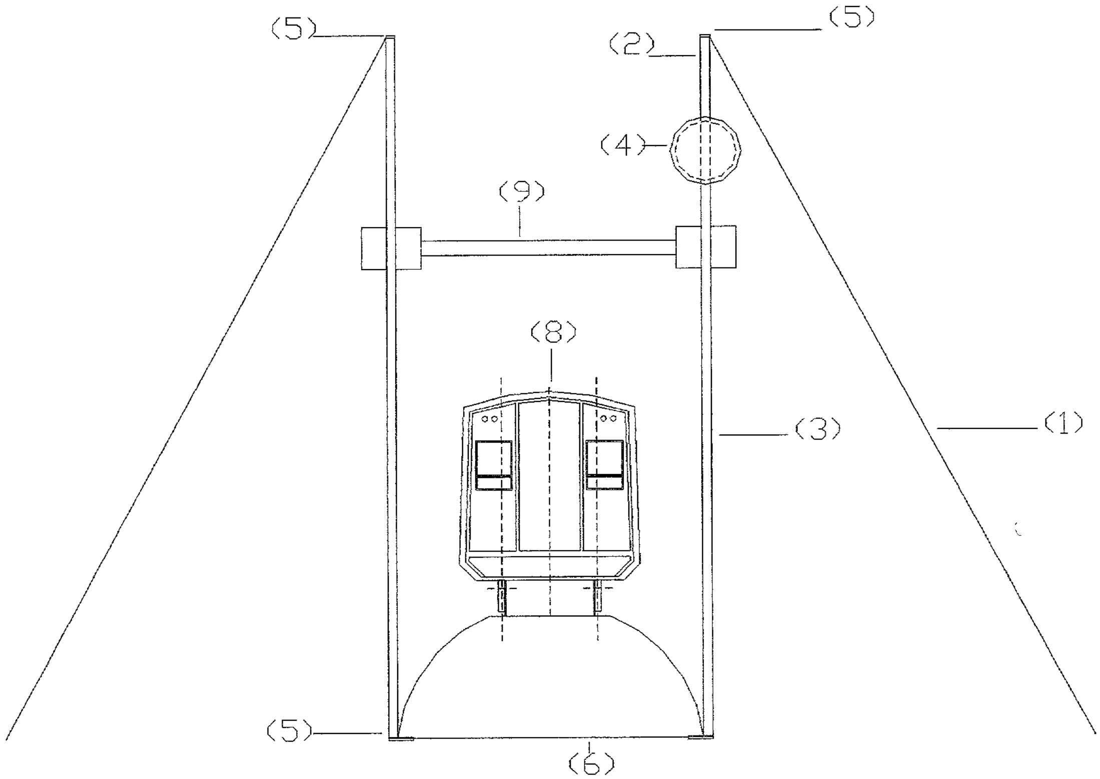

Fig. 2 A performance example of the horizontal polarization

(1) Wooden rack

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(3) ICW

(4) Pressure tube and rail-shaped spark gap

(5) Bus bar

(6) Terminating characteristic impedance

(7) Triggered first spark gap and high voltage source connection

(8) Train section in the testing chamber

(9) Synthetic column

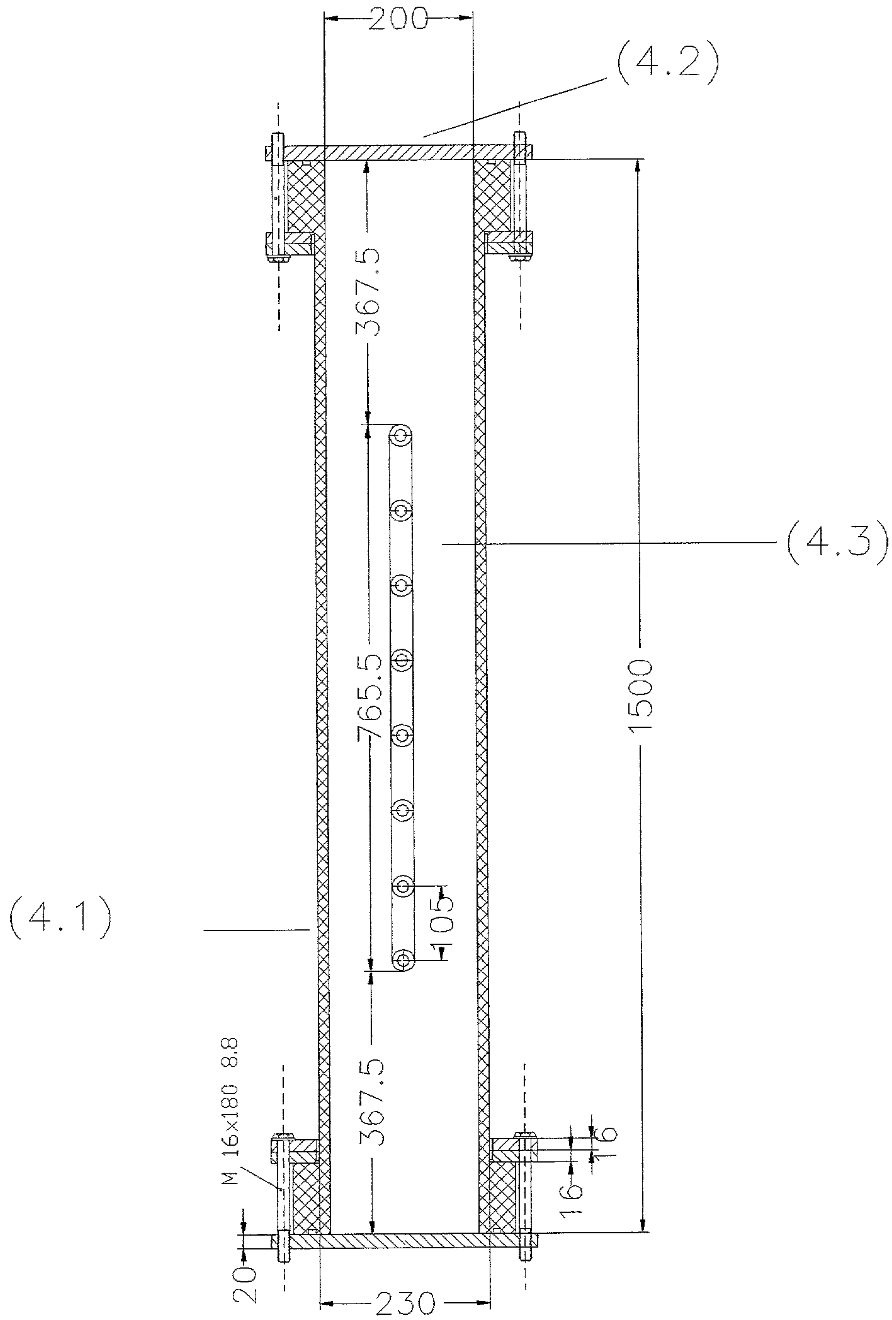

Fig. 3 A performance example of the pressure tube with electrode as detail of figure 1 and figure 2

(4.1) GFK-tube

(4.2) Lit

(4.3) Rail-shaped electrode, serves as connection for the single wave guides at the same time

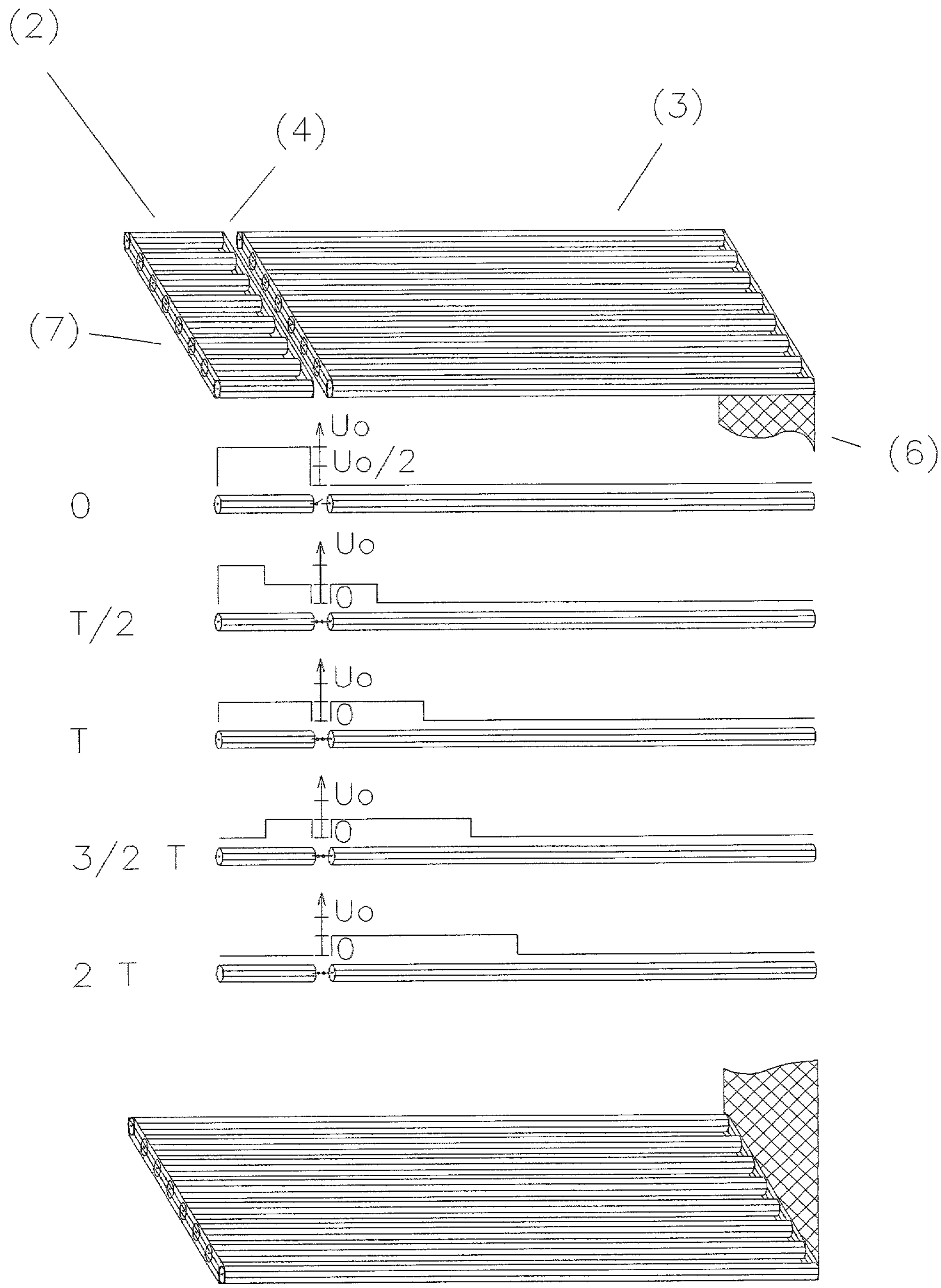

Fig. 4 Function

(2) IGW

(3) ICW

(4) Rail-shaped spark gap

(6) Terminating impedance

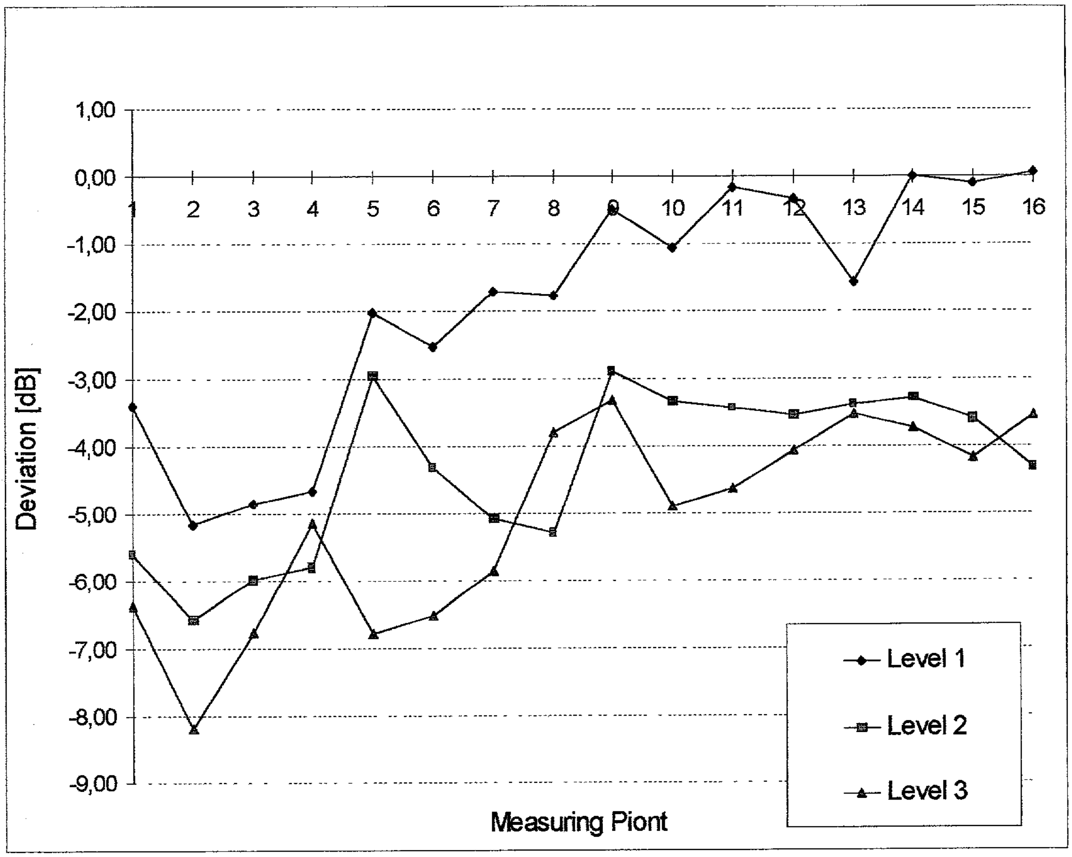

Fig. 5 6-dB-criteria of all measuring points in the testing chamber

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DECLARATION

ADDITIONAL INVENTOR(S)
Supplemental Sheet
Page ___ of ___

Name of Additional Joint Inventor, if any:		[ ] A petition has been filed for this unsigned inventor					
Given Name (first and middle [if any])				Family Name or Surname			
Inventor's Signature						**Date**	
Residence: City		**State**		**Country**		**Citizenship**	
Post Office Address							
Post Office Address							
City		**State**		**ZIP**		**Country**	

Name of Additional Joint Inventor, if any:		[ ] A petition has been filed for this unsigned inventor					
Given Name (first and middle [if any])				Family Name or Surname			
Inventor's Signature						**Date**	
Residence: City		**State**		**Country**		**Citizenship**	
Post Office Address							
Post Office Address							
City		**State**		**ZIP**		**Country**	

2-00

Name of Additional Joint Inventor, if any:		[ ] A petition has been filed for this unsigned inventor					
Given Name (first and middle [if any])				Family Name or Surname			
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Post Office Address	DEX						
City		**State**		**ZIP**	03054	**Country**	

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DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U S C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1 56 which became available between the filing date of the prior application and the national or PCT international filing date of this application

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number *(if applicable)*
PCT/DE99/00369	17/02/99	

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☐ Customer Number ____ → *Place Customer Number Bar Code Label here*
OR
☐ Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: ☐ Customer Number or Bar Code Label ____ OR ☐ Correspondence address below

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
2-00 Jan Paul	Wilbert, Dr.

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Post Office Address							
City		State		ZIP	82024	Country	

☒ Additional inventors are being named on the ____ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto